4.4 PALYNOLOGICAL STUDY (Table 11)

Out of the five *Alternanthera* species studied, data on the pollen morphology of *A. brasiliana* and *A. bettzickiana* could not be obtained due to microspore degeneration. In general, the pollen grains of *A. sessilis* (both leaf forms), *A. ficoidea* and *A. paronychioides* are small, isopolar, pantoporate and metareticulate. The size of the pollen grains is small (12.56–23.57 µm in length) with the average polar axis varying between 15.19–21.36 µm and the average equatorial axis ranging from 17.62–21.86 µm (Table 11).

Under the SEM, the apertures of *A. sessilis* and *A. ficoidea* are pantoporate with twelve round pores or occasionally, 14. Each of the pores is situated in a pentagonal face which contributes to the dodecahedric body of the pollen grains (Figure 93A & B, 94A & B, 95A, 96A & B). However, the pollen grains of *A. paronychioides* are different from those in *A. sessilis* and *A. ficoidea* by having approximately 14–18 pores. Most of the pores in *A. paronychioides* are round and are situated in a pentagonal face except for a few of them which are oval and are situated in a hexagonal face. Thus, the pollen grains of *A. paronychioides* are not dodecahedric but more or less spheroidal shaped. In the polar view, each oval pore is seen to be surrounded by six other round pores. *Alternanthera sessilis* 'Green' possesses the smallest pore (4.17 µm), followed by *A. sessilis* 'Red' (4.48 µm), *A. ficoidea* (4.83 µm) and the largest, *A. paronychioides* (6.06 µm).

The pores of the pollen grains of all the species studied are covered by a number of ektexinous bodies. The average number of ektexinous bodies in the red and green leaf forms of *A. sessilis* is the lowest, 28 and 29 respectively, followed by *A. ficoidea* (33) and *A. paronychioides* (36). The result seems to show a direct correlation between the number of ektexinous bodies and the size of the pores. For instance, the pores of *A. paronychioides* are the biggest (6.06 µm) and they have the most number of ektexinous

bodies (36) attached on it. The length of each ektexinous body is four to six times its width. It is rectangular, sinuous or elongated and has three to four distinct microspines attached onto it. These ektexinous bodies are arranged in a mosaic-like pattern, closely adjoined but separated from each other (Figure 93C, 94C, 95D, 96C & D).

The sexine of the pollen grains is metareticulate with a row of microspines attached distally on the mesoporia. These microspines are normally regularly arranged and very rarely irregularly arranged. They are conical with concave flanks with either blunt ends (red and green leaf forms of *A. sessilis* and *A. paronychioides*) or sharp ends (*A. ficoidea*). The average height of these microspines ranges from 0.22–0.45 µm. The pollen grains of all the species studied have perforated tectum with unevenly distributed perforations. Both sides of the mesoporia are completely covered by the tectum and hence the collumellae could not be seen. The perforations are distributed either at the top of the mesoporia, nearer to the pores (as seen in *A. sessilis*) or along the microspines at the top of the mesoporia (as seen in *A. ficoidea* and *A. paronychioides*) (Figure 93D, 94D, 95F, 96E& F).

The result of one-way ANOVA indicates that there is a significant difference at the $p < 0.05$ of all the species in the polar length (P), equatorial diameter (E) and the height of the microspines.

In *A. sessilis*, the Tukey's test reveals a non-significant difference ($p > 0.05$) in the polar length (green leaf form: 15.19 ± 1.19 µm; red leaf form: 15.48 ± 0.95 µm); equatorial diameter (green leaf form: 17.94 ± 1.02 µm; red leaf form: 17.69 ± 0.82 µm) and in the height of the microspines (green leaf form: 0.24 ± 0.04 µm; red leaf form: 0.22 ± 0.03 µm) (Appendices 4.4.1.2A−C). The result of the t-test also shows that there is no significant ($p > 0.05$) difference in the number of ektexinous bodies per pore between the two leaf forms (Appendix 4.4.1.5A). The only significant difference in both

the leaf forms is the pore diameter ($p < 0.05$) (Appendix 4.4.1.4A). Taken together, the pollen morphology of the green and red leaf forms is almost identical.

The Tukey's test and t-test suggest that *A. sessilis* 'Green' and *A. ficoidea* are significantly different in the polar length and height of the microspines ($p < 0.05$) (Appendices 4.4.1.2A & C) (Polar length: *A. sessilis* 'Green', 15.19 ± 1.19 µm; *A. ficoidea* : 14.55 ± 0.81 µm; microspine height: *A. sessilis* 'Green', 0.24 ± 0.04 µm; *A. ficoidea*: 0.29 ± 0.04 µm). Furthermore, the result of the t-test indicates that these two species are significantly different in the pore diameter and the number of ektexinous bodies covering per pore ($p < 0.05$) (Appendices 4.4.1.4B & 4.4.1.5B). However, both the species are not significantly different in the equatorial diameter ($p > 0.05$) (Appendix 4.4.1.2B) (*A. sessilis* 'Green': 17.94 ± 1.02 µm; *A. ficoidea*: 17.62 ± 0.76 µm).

The Tukey's test has also shown that *A. sessilis* 'Red' and *A. ficoidea* are significantly different in the polar length, height of microspines, pore diameter and the number of ektexinous bodies covering per pore ($p < 0.05$) (Appendices 4.4.1.2A & C, 4.4.1.4B, 4.4.1.5B) (Polar length: *A. sessilis* 'Red', 15.48 ± 0.9 5 µm; *A. ficoidea*: 14.55 ± 0.81 µm; microspine height: *A. sessilis* 'Red': 0.22 ± 0.03 µm; *A. ficoidea*: 0.29 ± 0.04 µm). Nevertheless, no significant differences are apparent in the equatorial diameter of these two species ($p > 0.05$) (Appendix 4.4.1.2B) (*A. sessilis* 'Red': 17.69 ± 0.82 µm; *A. ficoidea*: 17.62 ± 0.76 µm). The above findings therefore suggest that the pollen grains of *A. ficoidea* are different from those of *A. sessilis*.

The pollen grains of *A. paronychioides* are very different from those of the other two species in all the quantitative characters, as shown in the Tukey's test and independent sample t-test (Appendices 4.4.1.2A–C, 4.4.1.4D–F, 4.4.1.5D–F). In other words, the pollen grains of *A. paronychioides* are likely the largest with the biggest pores (6.06 µm) that are covered by the most number of ektexinous bodies (35.80 ±

2.59). On top of that, the microspines are the longest in the pollen grains of *A. paronychioides* (1.74 ± 0.19 µm).

All samples of *A. sessilis* ‘Red’ from different habitats demonstrate a significant difference at the $p < 0.05$ in the equatorial diameter (Appendix 4.4.1.3A) (planted in pots: 17.69 ± 0.82 µm; naturalized: 16.15 ± 0.64 µm; planted on ground: 17.25 ± 0.67 µm). Nevertheless, no significant differences are apparent in the equatorial diameter among the three samples of *A. sessilis* ‘Green’ ($p > 0.05$) (Appendix 4.4.1.3B) (lake: 17.94 ± 1.02 µm; ditches: 17.63 ± 0.97 µm; waste grounds: 17.75 ± 0.94 µm).